CLAM RESOURCE ENHANCEMENT IN CHEZZETCOOK HARBOUR, NOVA SCOTIA: A COMPARATIVE GROWTH STUDY [PROJECT UPDATE]

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Abstract

From the period of May 2001 through to December 2001, an experimental transplant was conducted in Chezzetcook, Nova Scotia, measuring the growth of soft-shell clams (*Mya arenaria*). In 2002 the opportunity arose to return to the flats and observe shell growth after one full growing season.

On November 8, 2002, in collaboration with the Eastern Shore Clam Fishers' Association, the remaining marked clams in the 2001 receiving area flat were extracted, along with another sample from the giving area. The same analyses found that the receiving area clams grew an average of 3.54 mm more in shell width after one year. A clam weight analysis was also performed and indicated that the clams in the receiving area had 51.2% greater average weight than the sample in the giving area. After one year mortality was approximately 25%.

For future transplants in Chezzetcook Harbour to successfully achieve financial gain, it is important to minimize breakage, and to carefully monitor the receiving ground to minimize disturbance from potential predators.

Résumé

De mai à décembre 2001, on a procédé à un transfert expérimental à Chezzetcook (Nouvelle-Écosse), en mesurant la croissance des myes (*Mya arenaria*). En 2002, on a pu revenir sur les gisements et observer la croissance de ces mollusques au terme d'une pleine saison de croissance.

Le 8 novembre 2002, en collaboration avec la Eastern Shore Clam Fishers' Association, on a extrait les myes marquées qui restaient dans le gisement récepteur de 2001 ainsi qu'un échantillon provenant du gisement donneur. Les analyses ont révélé qu'au bout d'un an la largeur de la coquille des myes du gisement récepteur avait augmenté en moyenne de 3,54 mm de plus. On a aussi procédé à une analyse du poids des myes et constaté que les myes du gisement récepteur avait un poids moyen supérieur de 51,2 % à celui des myes du gisement donneur. Au bout d'un an, la mortalité était d'environ 25 %.

Pour que les futures opérations de transfert dans le port de Chezzetcook soient rentables, il importe de réduire le plus possible les bris et de surveiller étroitement la zone de réception afin d'éviter les perturbations par des prédateurs possibles.

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1. Introduction

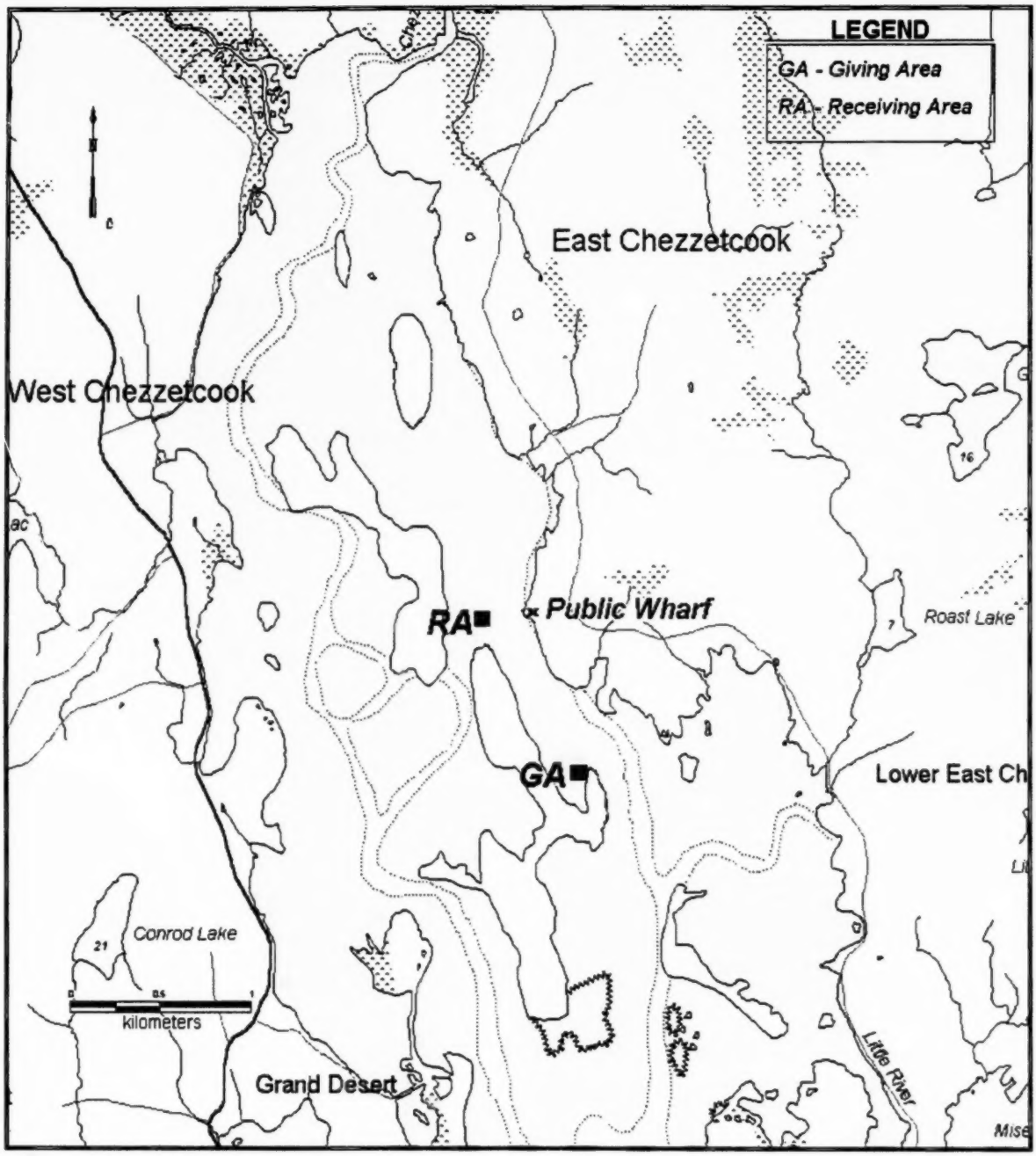
In collaboration with the Eastern Shore Clam Fishers' Association (ESCFA), an update of the project "Clam Resource Enhancement in Chezzetcook Harbour, N.S." with members of the Invertebrate Fisheries Division from DFO was set in place. Jill Moore, Rene Lavoie, and Ted Potter of DFO presented the results of the original study to the Association on July 10, 2002. With the remaining clams in the 2001 receiving area plot, it was feasible to return after a full year of growth and remeasure the individuals still remaining, then compare the growth with a group from the giving area. From the previous study, it was found that the clams in both sample areas had finished their growth for 2001 after the end of October, so arrangements were made to return at the end of October 2002 to finish the sampling.

This report presents a comparison of the 2002 clam growth between the giving and receiving areas. It also offers considerations to maximize benefits from larger transplants in the future.

2. Methods

On November 8, 2002, the final clam samples in the giving and receiving areas of Chezzetcook Harbour were taken (Fig.1). In the giving area (GA) a section of the flat was sampled to find clams of comparable size with the receiving area (RA). All GA clams were dug from the original flat where the 1000 clams were collected for transplant in August 2001. In the RA the clams had remained untouched since the spring sample on April 5, 2002. Within the staked receiving plot, the entire area was dug up and all remaining clams were brought back to BIO for processing. All individuals were dried, cleaned, and then measured for information on length, width, yearly annuli, shell edge, and weight. The caliper accuracy was within 1 mm, so all recorded measurements for length and width were rounded up to the nearest mm. All broken and dead animals were separated, and the total number of clams analysed for growth was 300 from the GA and 97 from the RA.

For the analysis of growth in 2001, clams #401-1000 had to be eliminated due to being moved to a different location and a delay of 13 days before replant. For this sample in 2002, all clams from 1-1000 that were found were included, since for this portion of the project the focus was on the 2002 growth season. All clams would have finished their fall growth at the same time, and begun their spring growth at the same time, therefore making inclusion of all clams possible.



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Nova Scotia Geomatics Centre
Coastal Series Map 11D14

Original Prepared by: Jennifer Hackett
Oceans and Coastal Management Division
Oceans and Environment Branch
Department of Fisheries and Oceans

Figure 1. Chezzetcook Harbour area map showing the designated giving and receiving areas.

3. Results

3.1 Mean and mode comparison

The results for the mean and mode comparison for both groups of clams are summarized in Table 1. In terms of shell width, the RA showed a difference of 3 mm in the mean and 5 mm in the mode over the GA. In terms of length, the RA showed a difference of 6 mm in the mean and 7 mm in the mode over the GA (Fig. 2). The results from this approach showed a tendency of faster growth in the RA, but called for confirmation through a comparison of growth of individual clams in both groups to support the results.

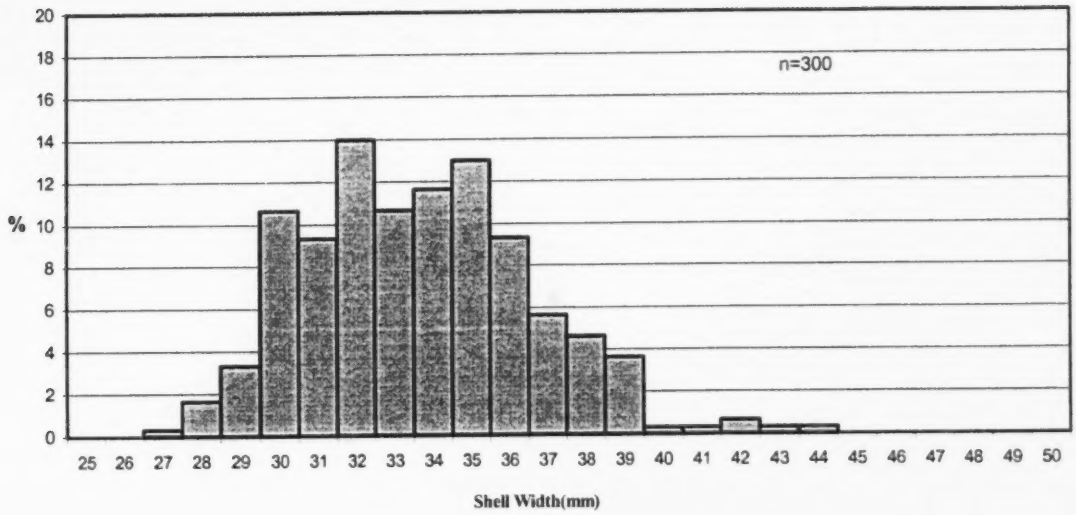
Table 1. Summary table for the comparison of mean and mode in the GA and RA.

Giving Area (n=300)

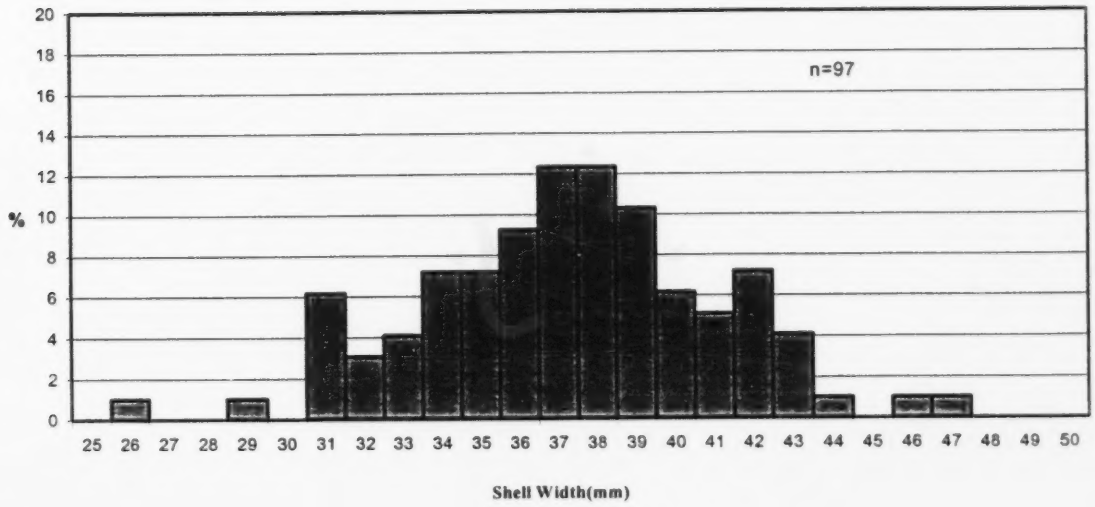
Width (mm)			Length (mm)		
mean	st dev	mode	mean	st dev	mode
34	2.9	32	57	4.6	53

Receiving Area (n=97)

Width (mm)			Length (mm)		
mean	st dev	mode	mean	st dev	mode
37	3.8	37	63	6.5	60



(a)



(b)

Figure 2. Distribution of shell width in (a) the giving area and (b) the receiving area.

3.2 Incremental growth

The average incremental growth of clams in the GA, represented by shell width, was 4.12 mm (Fig. 3). The average incremental growth in the RA was 7.57 mm, resulting in a supplemental increase of 3.45 mm in clams that were moved to the RA from the GA (Table 2). As in the previous study, a width to length conversion method of analysis was performed (Table 4). A regression analysis gave values to fit the conversion equation and ensure that the data was sound (Appendix A).

The same conversion was performed to calculate clam weight using length (Table 5), in order to find whether clams in the RA were not only bigger in shell size but also bigger in overall weight. In the GA, the average weight per clam was 18.77 g; in the RA the average weight per clam was 28.39 g (Table 3). The difference of 9.62 g indicated that the RA clams had approximately 51% greater average weight per clam. The weight at length relationships are presented in Figure 4.

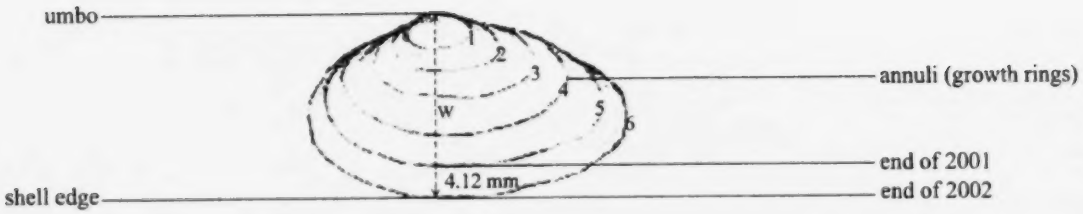
Table 2. Incremental shell width comparison (in mm) for growth of clams in the GA and transplanted clams in the RA in 2002.

	GA	RA
Count	300	97
Min	1	3
Max	8	11
Mean	**4.12**	**7.57**
St. Dev.	1.17	1.62

Table 3. Average growth in width and length (mm) and weight (g) in one full growing season.

	N	Width Spring 2002	Width Nov 8, 2002	Length	Weight
GA	300	29.51	33.68	56.7	18.77
RA	97	29.69	37.26	62.85	28.39

GA



RA

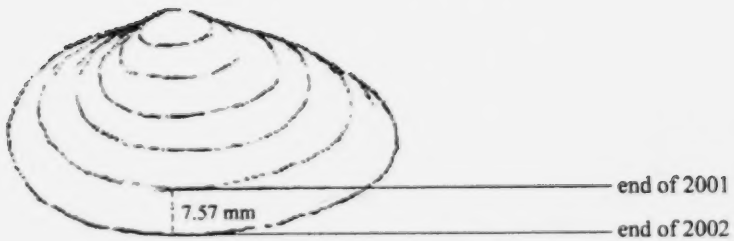


Figure 3. Incremental shell width comparison between the GA and the RA.

Table 4. Width to length conversion data for analysis of individual new growth of clams.

GA		RA	
Width (x)	*Length (y)*	Width (x)	*Length (y)*
24	*39.24*	24	*38.09*
26	*42.66*	26	*41.64*
28	*46.11*	28	*45.22*
29	*47.83*	29	*47.02*
30	*49.56*	30	*48.83*
31	*51.29*	31	*50.65*
32	*53.02*	32	*52.47*
33	*54.75*	33	*54.29*
34	*56.49*	34	*56.13*
35	*58.23*	35	*57.97*
36	*59.97*	36	*59.82*
38	*63.46*	38	*63.53*
40	*66.96*	40	*67.27*

Using the conversion equation:
$\ln(W) = b + a \ln(L)$
Shell widths are the known values, so in order to find length, the equation must be changed accordingly:
$\ln(L) = \text{Ln}(W)/a - b$

b= y intercept
a= slope
L = length
W = width

Example:

For **GA**:

W= 40 mm
b= -0.3458 (see Table A1)
a= 0.9561 (see Table A1)
$\ln(L) = \ln(40) / 0.9561 + 0.3458$
L = 66.9574 mm

For **RA**:

W = 40 mm
b= -0.1012 (see Table A2)
a= 0.8981 (see Table A2)
$\ln(L) = \ln(40) / 0.8981 + 0.1012$
L= 67.2654 mm

Table 5. Length to weight conversion for the GA and RA.

GA		RA	
Length (mm)	*Weight (g)*	Length (mm)	*Weight (g)*
50	*13.17*	50	*14.32*
52	*14.60*	52	*16.01*
54	*16.14*	54	*17.82*
56	*17.77*	56	*19.77*
58	*19.49*	58	*21.84*
60	*21.32*	60	*24.06*
62	*23.25*	62	*26.41*
64	*25.28*	64	*28.91*
66	*27.42*	66	*31.55*
68	*29.66*	68	*34.35*
70	*32.02*	70	*37.30*

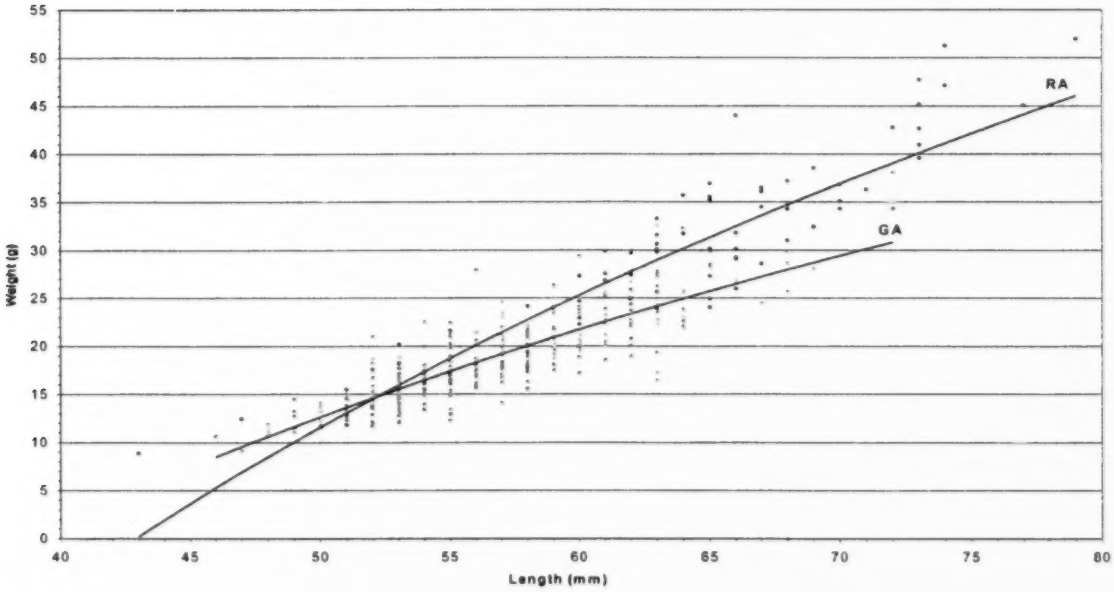


Figure 4. Distribution of total clam weight at length in the GA and the RA.

4. Conclusion and Discussion

The results of the 2002 sampling confirm the results of the original study in 2001 that an increase of growth in clams can be achieved by transplanting them from the giving area to the receiving area.

If fishermen transplanted a large number of clams (eg. 1 ton, or 183-12 lb buckets) the results of this study indicate there would be approximately 51% greater weight of clams in the RA than for an equivalent number of clams in the GA, minus mortality allowances. From the period between August 2001 and November 2002 the percentage of dead clams was approximately 25%. There is no guarantee that mortality from a large transplant would be greater or less than 25%, but there would be mortality regardless, due to predation, handling, transport stress, etc. This must be taken into consideration while calculating the value added in doing a transplant.

The clam fishery in Chezzetcook can be enhanced for the future, but there are several considerations to be made while planning the operation:

- the transfers should take place in one tide (dig only as many in one day as can be transplanted) to avoid trauma to the transplanted clams
- a tool such as a bulb planter should be used to regulate the depth that clams are re-buried
- handling should be kept to a minimum
- potential predators like seagulls should be kept away until the tide has covered transplanted clams
- there should be careful monitoring of the receiving ground to ensure no poaching or general disturbance

The value of transplanting clams can be affected at the time of harvest due to a certain amount of breakage. It would be very beneficial to acquire information on this point, and include it into the planning of any future transplants in order to achieve financial gain for fishermen.

Acknowledgements

Special thanks to Robert Mannette and Donald Renouf for their time and contributions in the field work for this project. Also thank you to Ted Potter, Maureen Butler, and Dave Duggan for their continued interest and support.

References

Moore, J.A., G. Robert, M.A.E. Butler, and R.E. Lavoie. 2002. Clam Resource Enhancement in Chezzetcook Harbour, Nova Scotia. Can. Ind. Rep. Fish. Aquat. Sci. 266: vii + 42 p.

Appendix A

Table A1. Width-length regression analysis for the giving area.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.8771
R Square	0.7694
Adj R Square	0.7686
Standard Error	0.0417
Observations	300

ANOVA

	df	*SS*	*MS*	*F*	*Sig F*
Regression	1	1.7327	1.7327	994.2062	6.18E-97
Residual	298	0.5194	0.0017		
Total	299	2.2521			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.3458	0.1224	-2.8257	0.0050	-0.5866	-0.1050
X Variable 1	0.9561	0.0303	31.5310	6.2E-97	0.8964	1.0158

Table A2. Width-length regression analysis for clams in the receiving area.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.917
R Square	0.841
Adj R Square	0.839
Standard Error	0.041
Observations	97

ANOVA

	df	*SS*	*MS*	*F*	*Sig F*
Regression	1	0.8648	0.8648	502.654	1.02E-39
Residual	95	0.1634	0.0017		
Total	96	1.0283			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.1012	0.1657	-0.6108	0.5428	-0.4302	0.2277
X Variable 1	0.8981	0.0401	22.4200	1E-39	0.8186	0.9776

Table A3. Length-weight regression analysis for the giving area.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.85621
R Square	0.73310
Adj R Square	0.73220
Standard Error	0.12703
Observations	300

ANOVA

	df	*SS*	*MS*	*F*	*Sig F*
Regression	1	13.20757	13.20757	818.51039	1.811E-87
Residual	298	4.80856	0.01614		
Total	299	18.01614			

	Coefficients	*Stan. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-7.74821	0.37233	-20.81023	5.08E-60	-8.48093	-7.01549
X Variable 1	2.63968	0.09227	28.60962	1.811E-87	2.45811	2.82126

Table A4. Length-weight regression for the receiving area.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93395
R Square	0.87227
Adj R Square	0.87092
Standard Error	0.11569
Observations	97

ANOVA

	df	*SS*	*MS*	*F*	*Sig F*
Regression	1	8.68266	8.68266	648.74453	3.092E-44
Residual	95	1.27146	0.01338		
Total	96	9.95412			

	Coefficients	*Stan.Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-8.47089	0.46216	-18.3287	5.911E-33	-9.3884	-7.5534
X Variable 1	2.84572	0.11173	25.4704	3.092E-44	2.6239	3.0675

Appendix B

Table B1. Descriptive Statistics for (a) the giving area and (b) the receiving area.

GA

Width		*Length*	
n=300			
Mean	33.63	Mean	56.7
Standard Error	0.17	Standard Error	0.263
Median	33.5	Median	56
Mode	32	Mode	53
Standard Deviation	2.949	Standard Deviation	4.56
Sample Variance	8.695	Sample Variance	20.75
Kurtosis	0.123	Kurtosis	-0.051
Skewness	0.438	Skewness	0.409
Range	17	Range	26
Minimum	27	Minimum	46
Maximum	44	Maximum	72
Count	300	Count	300
Confidence Level (95%)	0.335	Confidence Level (95%)	0.518

RA

Width		*Length*	
n=97			
Mean	37.26	Mean	62.85
Standard Error	0.383	Standard Error	0.66
Median	37	Median	63
Mode	37	Mode	60
Standard Deviation	3.776	Standard Deviation	6.496
Sample Variance	14.256	Sample Variance	42.195
Kurtosis	0.218	Kurtosis	0.309
Skewness	-0.138	Skewness	-0.131
Range	21	Range	36
Minimum	26	Minimum	43
Maximum	47	Maximum	79
Count	97	Count	97
Confidence Level (95%)	0.761	Confidence Level (95%)	1.309

Appendix C

Table C1. Size frequency data for shell width in (a) the receiving area and (b) the giving area.

(a)

RA		n=97
Width (mm)	# of Samples	% of Sample Size
25	0	0
26	1	1.03
27	0	0
28	0	0
29	1	1.03
30	0	0
31	6	6.19
32	3	3.09
33	4	4.12
34	7	7.22
35	7	7.22
36	9	9.28
37	12	12.37
38	12	12.37
39	10	10.31
40	6	6.19
41	5	5.15
42	7	7.22
43	4	4.12
44	1	1.03
45	0	0
46	1	1.03
47	1	1.03
48	0	0
49	0	0
50	0	0

(b)

GA		n=300
Width (mm)	# of Samples	% of Sample Size
25	0	0
26	0	0
27	1	0.33
28	5	1.66
29	10	3.33
30	32	10.66
31	28	9.33
32	42	14
33	32	10.66
34	35	11.66
35	39	13
36	28	9.33
37	17	5.66
38	14	4.66
39	11	3.66
40	1	0.33
41	1	0.33
42	2	0.66
43	1	0.33
44	1	0.33
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0

Appendix D

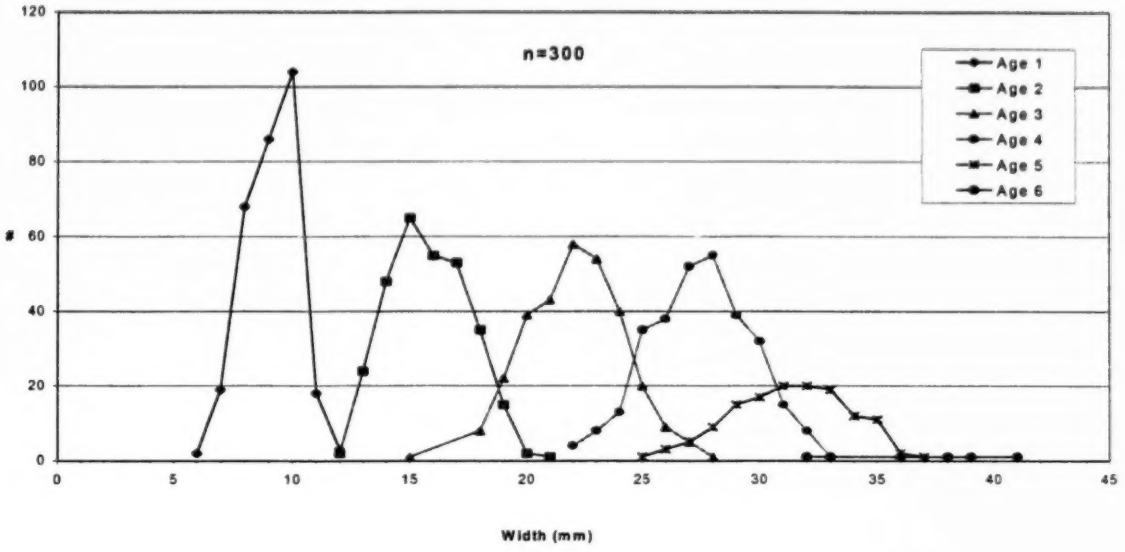


Figure D1. Size at age graph for clams in the giving area.

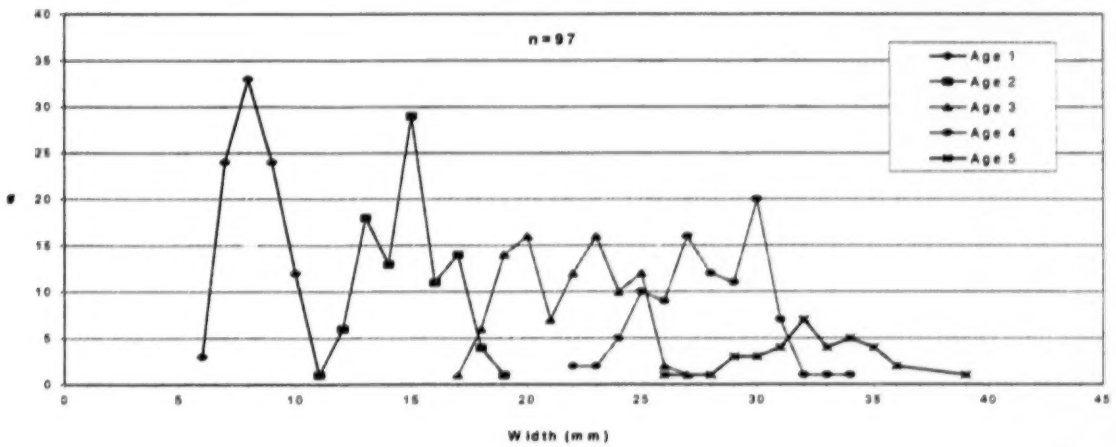


Figure D2. Size at age graph for clams in the receiving area.